REMARKS

In the last Office Action, the Examiner rejected claims 1, 24-26 and 34 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,583,446 to Takeuchi et al. ("Takeuchi"). Claims 1, 3, 4 and 24-35 under 35 U.S.C. §102(b) as being anticipated by European Patent Application No. EP 0 797 117 A1 to Muramatsu et al. ("Muramatsu"). Claim 38 was rejected under 35 U.S.C. §103(a) as being unpatentable over Muramatsu in view Niwa. Claim 40 was rejected under 35 U.S.C. §103(a) as being unpatentable over Takeuchi.

In accordance with the present response, the specification has been suitably revised to add a cross-reference to copending International Application Ser. No. PCT/JP00/01361, filed March 6, 2000 claiming a priority date of March 17, 1999. Independent claims 1 and 34 have been amended to incorporate the subject matter of claims 5 and 35, respectively, which have been canceled. Claim 37 has been amended to depend on claim 34 in view of the cancellation of claim 35. Claims 27, 29, 31 and 33 have been canceled. New claims 41-50 have been added to provide a fuller scope of coverage. Claims 41-43, 44-46 and 47-49 are directed to the non-elected species of Fig. 5. The previously submitted abstract has been amended to more clearly reflect the invention to which the amended claims are directed.

Applicants respectfully submit that independent claims 1, 34 and 40 are generic to both the elected species of Fig. 1 and the non-elected species of Fig. 5. Non-elected claims 41-43, 44-46 and 47-49 are being retained in the present application pending possible withdrawal of the restriction requirement or allowance of a generic or a sub-generic claim.

Applicants respectfully request reconsideration of their application in light of the following discussion.

Brief Summary of the Invention

The present invention is directed to an optical microcantilever.

Fig. 13 shows a conventional optical microcantilever. As described in the specification (pgs. 3-4), the conventional optical microcantilever shown in Fig. 13 has not been able to prevent the high loss of propagating light occurring in the optical waveguide. The loss of propagating light diminishes the ability of the optical microcantilever to propagate light efficiently toward the microscopic aperture formed at the tip of the optical waveguide. This results in the inability to generate near-field light at the microscopic aperture.

The present invention overcomes the drawbacks of the conventional art. Fig. 1 shows an embodiment of an optical microcantilever 10 according to the present invention embodied in the claims. The optical microcantilever 10 comprises an optical waveguide 2 for propagating light and has a light input/output end 8, a free end, a first side (lower side in Fig. 1), and a second side (upper side in Fig. 1) opposite the first side. A tip 5 is formed on the first side and at the free end of the optical waveguide 2 and has a microscopic aperture 6. A light blocking layer 3 is disposed on the first side of the optical waveguide 2. A reflecting film 4 is disposed on the second side of the optical waveguide 2. According to the present invention, a reflecting member 7 (e.g., a mirror) forms part of the reflecting film 4 and is disposed at the free end of the optical waveguide 2. The reflecting member 7 has a generally planar surface for reflecting light propagated by the optical waveguide 2 and for guiding the reflected light towards the microscopic aperture 6 of the tip 5.

Preferably, the optical waveguide 2 has a longitudinal axis, a first section extending in a direction generally parallel to the longitudinal axis, and a second section extending from the first section at a preselected angle relative to the longitudinal axis so that the light

reflected by the reflecting member 7 is guided towards the microscopic aperture 6 to generate near-field light at the microscopic aperture 6.

By the foregoing construction, the propagating light propagated by the optical waveguide is effectively guided by the reflecting member towards the microscopic aperture in the tip of the optical microcantilever so that sufficient near-field light is generated at the microscopic aperture.

Traversal of Prior art Rejections

Rejection Under 35 U.S.C. §102(b)

Claims 1, 24-26 and 34 were rejected under 35 U.S.C. §102(b) as being anticipated by Takeuchi. Applicants respectfully traverse this rejection and submit that amended independent claims 1 and 34 and dependent claims 24-26 recite subject matter which is not identically disclosed or described in Takeuchi.

Amended independent claim 1 is directed to an optical microcantilever for a scanning near field microscope and requires an optical waveguide having a light input/output end, a free end for propagating light incident from the light input/output end, a first side, and a second side opposite to the first side. Amended claim 1 further requires a tip formed

on the first side and at the free end of the optical waveguide and having a microscopic aperture, a light blocking film disposed on the first side of the optical waveguide, a reflecting film disposed on the second side of the optical waveguide, and a reflecting member forming part of the reflecting film and disposed at the free end of the optical waveguide, the reflecting member having a generally planar surface for reflecting light propagated from the light input/output end of the optical waveguide and for guiding the reflected light towards the microscopic aperture of the tip, or for reflecting light propagated from the microscopic aperture towards the light input/output end of the optical waveguide. No corresponding structural combination is disclosed or described by Takeuchi.

Amended independent claim 34 is also directed to an optical microcantilever and requires an optical waveguide for propagating light and having a first side, a second side opposite to the first side, and a tip portion formed on the first side and at a free end of the optical waveguide, the tip portion having a microscopic aperture. Amended claim 34 further requires a light blocking film disposed on the first side of the optical waveguide, a reflecting film disposed on the second side of the optical waveguide, and a reflecting

member forming part of the reflecting film and disposed at the free end of the optical waveguide, the reflecting member having a generally planar surface for reflecting light propagated by the optical waveguide and for guiding the reflected light towards the microscopic aperture to generate near-field light at the microscopic aperture. Again, no corresponding structural combination is disclosed or described by Takeuchi.

Takeuchi discloses an electro-optically controlled measurement probe system (Figs. 25a-25b, 26). The probe system has an arm 21 (optical waveguide), a tip 51 having a microscopic aperture, and a reflecting member 86 (Fig. 25(a)) or 88 (Fig. 26) disposed on a side of the arm 21. However, Takeuchi clearly does not disclose or describe a light blocking film and, furthermore, a light blocking film which is disposed on a side of the optical waveguide opposite the side on which the reflecting film is disposed, as recited in each of amended independent claims 1 and 34. In the absence of the foregoing disclosure recited in amended independent claims 1 and 34, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art reference of

each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to establish unpatentability of the claimed invention anticipation under § 102 can not be found".); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by Takeuchi for the reasons stated above. Furthermore, Takeuchi does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Takeuchi's probe system to arrive at the claimed invention.

Claims 24-26 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from the references at least in the same manner as claim 1.

In view of the foregoing, applicants respectfully request that the rejection of claims 1, 24-26 and 34 under 35 U.S.C. §102(b) as being anticipated by Takeuchi be withdrawn.

Rejections Under 35 U.S.C. §103(a)

Claims 1, 3, 24-26, 28, 30, 32, 34 and 40[1] were rejected under 35 U.S.C. §103(a) as being unpatentable over Muramatsu. Applicants respectfully traverse this rejection and submit that the teachings of Muramatsu do not disclose or suggest the subject matter recited in amended independent claims 1 and 34 and dependent claims 3, 24-26, 28, 30, 32.

Independent claims 1 and 34 are directed to an optical microcantilever for a scanning near field microscope and require a reflecting film disposed on the second side of the optical waveguide, and a reflecting member forming part of the reflecting film and disposed at the free end of the optical waveguide, the reflecting member having a generally planar surface for reflecting light propagated from the light input/output end of the optical waveguide and for guiding the reflected light towards the microscopic aperture. No corresponding structural and functional combination is disclosed or suggested by Muramatsu.

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[1] The statement of rejection in section 4 of the Office Action does not include independent claim 40 as being rejected under 35 U.S.C. §103(a) over Muramatsu. However, in the paragraph bridging pages 7-8 of the Office Action the Examiner addresses the obviousness of claim 40 over Muramatsu. Accordingly, for the purpose of this response, applicants presume that the Examiner rejected claim 40 under 35 U.S.C. §103(a) as being unpatentable over Muramatsu.

Independent claim 40 is also directed to an optical microcantilever and requires a reflecting film disposed on the second side of the optical waveguide and a reflecting member forming part of the reflecting film. Claim 40 further requires that the reflecting member is disposed on at least a portion of the optical waveguide and has a generally planar surface disposed proximate the free end of the optical waveguide at a preselected angle relative to the longitudinal axis for reflecting light propagated by the optical waveguide and for guiding the reflected light towards the microscopic aperture to generate near-field light at the microscopic aperture. Again, no corresponding structural and functional combination is disclosed or suggested by Muramatsu.

Muramatsu discloses an optical waveguide probe and optical system. In one embodiment shown in Fig. 2(f), the optical waveguide probe has a substrate portion 2, an optical waveguide portion 8 formed in the substrate portion 2, and a mirror (reflecting member) 30 for changing the direction of light transmitted by the optical waveguide portion 8. However, the optical waveguide probe in the embodiment of Fig. 2(f) does not have a reflecting film disposed on the second side of the optical waveguide such that the reflecting member forms part of the reflecting film, as required by each of independent claims 1, 34 and 40.

In another embodiment shown in Fig. 9(a) of Muramatsu, the optical waveguide probe has a substrate 2 and a reflecting film 24 disposed on a side of the substrate 2. However, the optical waveguide probe of Fig. 9(a) does not have a reflecting member forming part of the reflecting film, and further that the reflecting member has a generally planar surface for reflecting light propagated from the light input/output end of the optical waveguide and for guiding the reflected light towards the microscopic aperture, as required by each of independent claims 1, 34 and 40.

While recognizing that Muramatsu does not disclose an embodiment of an optical microcantilever having a reflecting member forming part of a reflecting film, as recited in independent claim 1, 34 and 40, the Examiner contends that one of ordinary skill in the art would have found it obvious, at the time the invention was made, to modify the probe in Fig. 2(f) of Muramatasu in view of the probe in Fig. 2(f) of Muramatasu for the purpose of making the reflecting member part of the reflecting film in order to improve the measurement capability of the probe. Applicants respectfully disagree with the Examiner's contention.

First, applicants respectfully submit that none of the embodiments of the optical waveguide probe disclosed by Muramatsu has both a reflecting film and a reflecting member,

as required by independent claims 1, 34 and 40. More specifically, in the embodiment shown in Fig. 2(f) of Muramatsu, the optical waveguide probe has a mirror (reflecting member) 30 for changing the direction of light transmitted by an optical waveguide portion 8, but does not have, in addition to the reflecting member, a reflecting film disposed on a side of the optical waveguide. In the embodiment shown in Fig. 9(a) of Muramatsu, the optical waveguide probe has a reflecting film 24 disposed on a side of the substrate 2, but does not have, in addition to the reflecting film, a reflecting member.

Second, in addition to not teaching both a reflecting member and a reflecting film, Muramatsu does not disclose or suggest a reflecting member forming part of a reflecting film, as required by independent claims 1, 34 and 40.

Moreover, claim 40 requires that the reflecting member is disposed on at least a portion of the optical waveguide and has a generally planar surface disposed proximate the free end of the optical waveguide at a preselected angle relative to the longitudinal axis for reflecting light propagated by the optical waveguide and for guiding the reflected light towards the microscopic aperture to generate near-field light at the microscopic aperture.

While Muramatsu discloses a reflecting member 30 (Fig. 2(f)) disposed at a preselected angle for changing the direction of light passing through the waveguide portion (col. 4, lines 12-15), the reflecting member 30 is disposed inside the waveguide portion 2 and does not form part of a reflecting film, as set forth above for independent claim 40.

Thus independent claims 1, 34 and 40 are not rendered obvious by Muramatsu because the reference does not suggest the modifications that would be needed to replicate the claimed invention. In the context of obviousness rejections based upon the purported obviousness of effecting a required modification, the Federal Circuit has held that "[t]he mere fact that the prior art may be modified in [a given] manner ... does not make the modification obvious unless the prior art suggested the desirability of the modification". In re Fritch, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992). There is nothing in Muramatsu that would have suggested the structural combination of the optical microcantilever recited in independent claims 1, 34 and 40.

Claims 3, 24-26, 28, 30 and 32 depend on and contain all of the limitations of independent claim 1 and, therefore, distinguish from the reference at least in the same manner as claim 1.

Accordingly, applicants respectfully submit that claims 1, 3, 24-26, 28, 30, 32, 34 and 40 patentably distinguish over the prior art of record and that the claim rejection under 35 U.S.C. §103(a) should be withdrawn.

Claim 38 was rejected under 35 U.S.C. §103(a) as being unpatentable over Muramatsu in view of Niwa. Applicants respectfully traverse this rejection and submit that the combined teachings of Muramatsu and Niwa do not disclose or suggest the subject matter recited in claim 38.

Muramatsu does not disclose or suggest the subject matter recited in amended independent claim 34 as set forth above for the rejection of claims 1, 3, 24-26, 28, 30, 32, 34 and 40 under 35 U.S.C. §103(a). Claim 38 depends on and contains all of the limitations of independent claim 34 and, therefore, distinguishes from Muramatsu at least in the same manner as claim 34.

The secondary reference to Niwa has been cited by the Examiner for its disclosure of a reflecting film disposed on a section of a waveguide. However, Niwa does not disclose or suggest both a reflecting member and a reflecting film, and further that the reflecting member forms part of the reflecting film, as required by independent claim 34, from which claim 38 depends. Since Niwa does not disclose or suggest this structural feature, it does not cure the

deficiency of Muramatsu. Accordingly, one ordinarily skilled in the art would not have been led to modify the references to attain the claimed subject matter.

In view of the foregoing, applicants respectfully request that the rejection of claim 38 under 35 U.S.C. §103(a) as being unpatentable over Muramatsu in view of Niwa be withdrawn.

Claim 40 was rejected under 35 U.S.C. §103(a) as being unpatentable over Takeuchi. Applicants respectfully traverse this rejection and submit that the teachings of Takeuchi does not disclose or suggest the subject matter recited in independent claim 40.

Independent claim 40 is directed to an optical microcantilever and requires a reflecting member forming part of the reflecting film and being disposed on at least a portion of the optical waveguide, the reflecting member having a generally planar surface disposed proximate the free end of the optical waveguide at a preselected angle relative to the longitudinal axis for reflecting light propagated by the optical waveguide and for guiding the reflected light towards the microscopic aperture to generate near-field light at the microscopic aperture.

Thus independent claim 40 requires that the reflecting member has a generally planar surface disposed

proximate the free end of the optical waveguide at a preselected angle relative to the longitudinal axis for reflecting light propagated by the optical waveguide and for guiding the reflected light towards the microscopic aperture to generate near-field light at the microscopic aperture. No corresponding feature is disclosed or suggested by Takeuchi.

Takeuchi discloses an electro-optically controlled measurement probe system (Figs. 25a-25b, 26). The probe system has an arm 21 (optical waveguide), a tip 51 having a microscopic aperture, and a reflecting member 86 (Fig. 25(a)) or 88 (Fig. 26) disposed on a side of the arm 21. While acknowledging that Takeuchi does not disclose that the reflecting member 86 or 88 is disposed at a preselected angle relative to a longitudinal axis of the optical waveguide (Office Action, pg. 9, lines 4-5), the Examiner contends that the reflecting member 86 or 88 must be disposed at a preselected angle relative to the longitudinal axis in order to have the light propagate correctly through the aperture. Applicants respectfully disagree with the Examiner's contention.

Figs. 25a and 26 of Takeuchi clearly show that the reflecting members 86 and 88 are not disposed at an angle relative to the longitudinal axis of the optical waveguide 21. Furthermore, there is no disclosure in the specification,

abstract and claims of Takeuchi to the effect that the reflecting member 86 or 88 is disposed at an angle relative to the longitudinal axis of the optical waveguide 21.

Moreover, although not clear from the Takeuchi disclosure, it appears that the reflecting members 86 and 88 in Takeuchi are made of a material which irradiate the probe tip 51 without necessarily being disposed at an angle relative to the longitudinal axis of the optical waveguide 21. For example, the reflecting member 88 is made of an optically active material which becomes conductive upon irradiation with light, at which time the probe tip 51 becomes electrically connected to an electrical path 52 (col. 17, lines 58-62).

Thus independent claim 40 is not rendered obvious by Takeuchi because the reference does not suggest the modifications that would be needed to replicate the claimed invention. In the context of obviousness rejections based upon the purported obviousness of effecting a required modification, the Federal Circuit has held that "[t]he mere fact that the prior art may be modified in [a given] manner ... does not make the modification obvious unless the prior art suggested the desirability of the modification". In re Fritch, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992). There is nothing in Takeuchi that would have suggested the structural combination of the optical microcantilever recited in independent claim 40.

In view of the foregoing, applicants respectfully request that the rejection of claim 40 under 35 U.S.C. §103(a) as being unpatentable over Takeuchi be withdrawn.

Applicants respectfully submit that the prior art of record also does not disclose or suggest the subject matter recited in newly added claims 41-50.

New claims 41-43, 44-46 and 47-50 depend on and contain all of the limitations of independent claims 1, 34 and 40, respectively, and, therefore, distinguish from the references at least in the same manner as claims 1, 34 and 40.

Moreover, there are separate grounds for patentability of new dependent claims 41-49 which are directed to the structure of the first and second channels formed in the support section for supporting and accommodating an optical fiber. No corresponding structure is disclosed or suggested by the prior art of record.

In view of the foregoing amendments and discussion, the application is believed to be in allowable form. Accordingly, favorable reconsideration and allowance of the claims are most respectfully requested.

Respectfully submitted,

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ABSTRACT OF THE DISCLOSURE

An optical microcantilever has an optical waveguide for propagating light. The optical waveguide has a first side, a second side opposite to the first side, and a tip portion formed on the first side and at a free end of the optical waveguide. The tip portion has a microscopic aperture. A light blocking film is disposed on the first side of the optical waveguide. A reflecting film is disposed on the second side of the optical waveguide. A reflecting member forms part of the reflecting film and is disposed at the free end of the optical waveguide. The reflecting member has a generally planar surface for reflecting light propagated by the optical waveguide and for guiding the reflected light towards the microscopic aperture to generate near-field light at the microscopic aperture.